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Yamada et al.

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(54) **IMAGE FORMING APPARATUS AND STORING MEDIUM**

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(51) **Int. Cl.**
G03G 15/00 (2006.01)

(52) **U.S. Cl.**
USPC **399/49**

(58) **Field of Classification Search**
USPC 399/49, 44, 301
See application file for complete search history.

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Assistant Examiner — Rodney Bonnette
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(57) **ABSTRACT**

An image forming apparatus is provided. The image forming apparatus includes: a forming unit configured to form an image on a relatively moving object, the image including a mark; a first detection unit configured to detect the mark formed by the forming unit so as to obtain a first detection result; a correction unit configured to execute a correction process in which an image forming condition of the image forming unit is changed based on the first detection result; a setting unit configured to set the correction process not to be executed when a value related to a correction accuracy of the correction unit is lower than a reference value; and a control unit configured to control the correction process based on the setting by the setting unit.

14 Claims, 14 Drawing Sheets

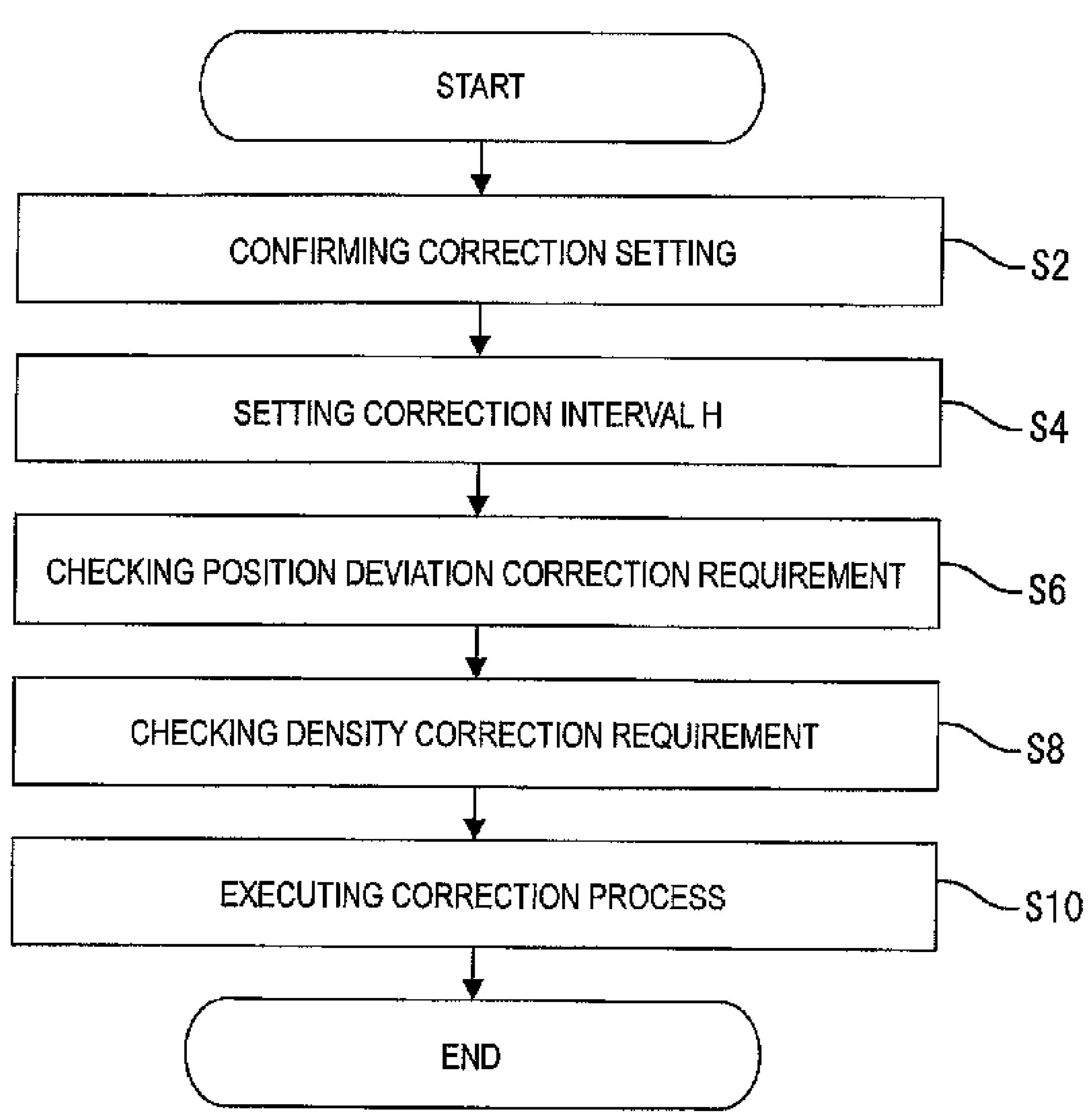

FIG. 1

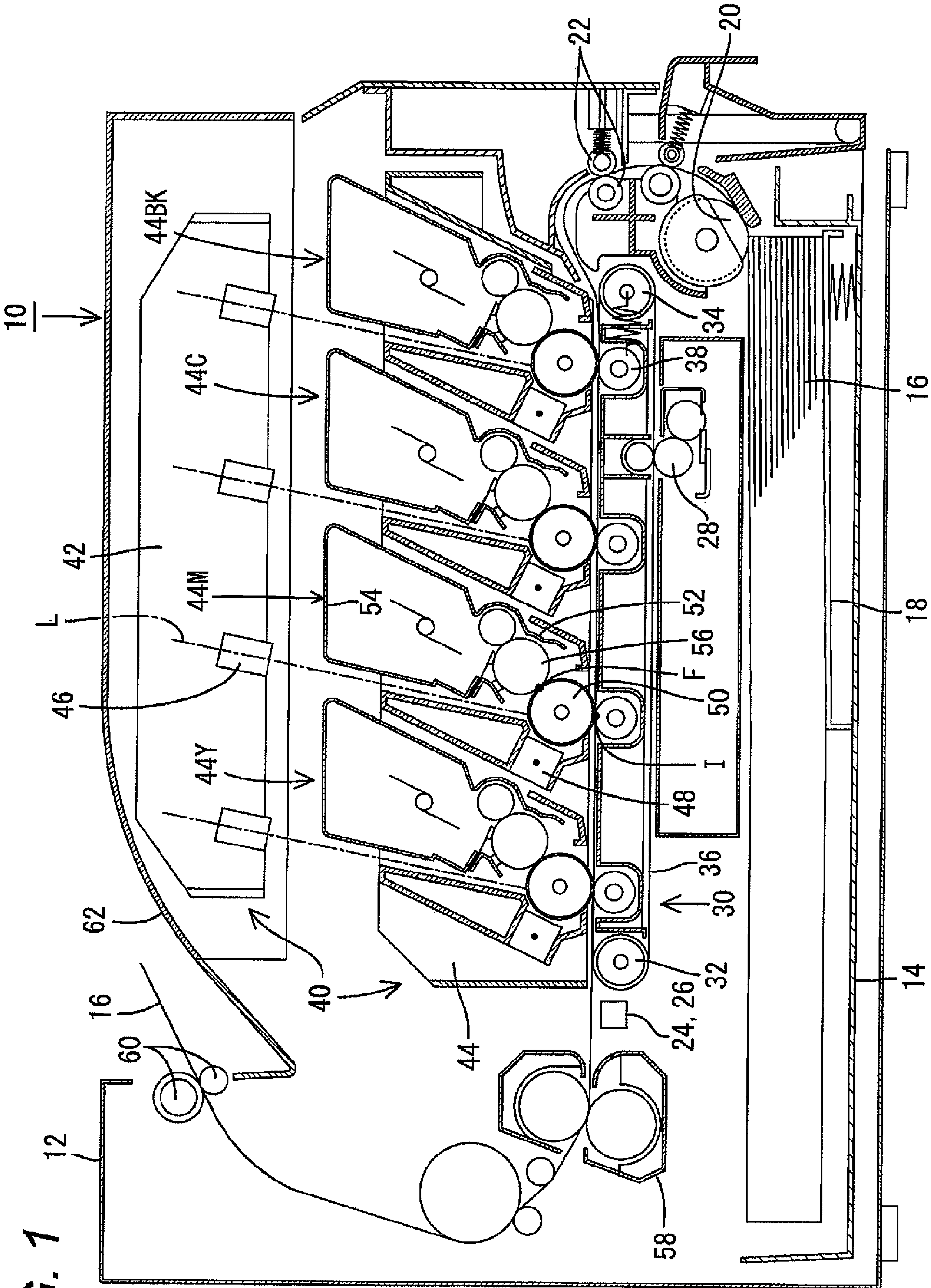
10
12
14
16
18
20
22
24, 26
28
30
32
34
36
38
40
42
44
44BK
44C
44M
44Y
46
48
50
52
54
56
58
60
62
L
F
I

FIG. 2

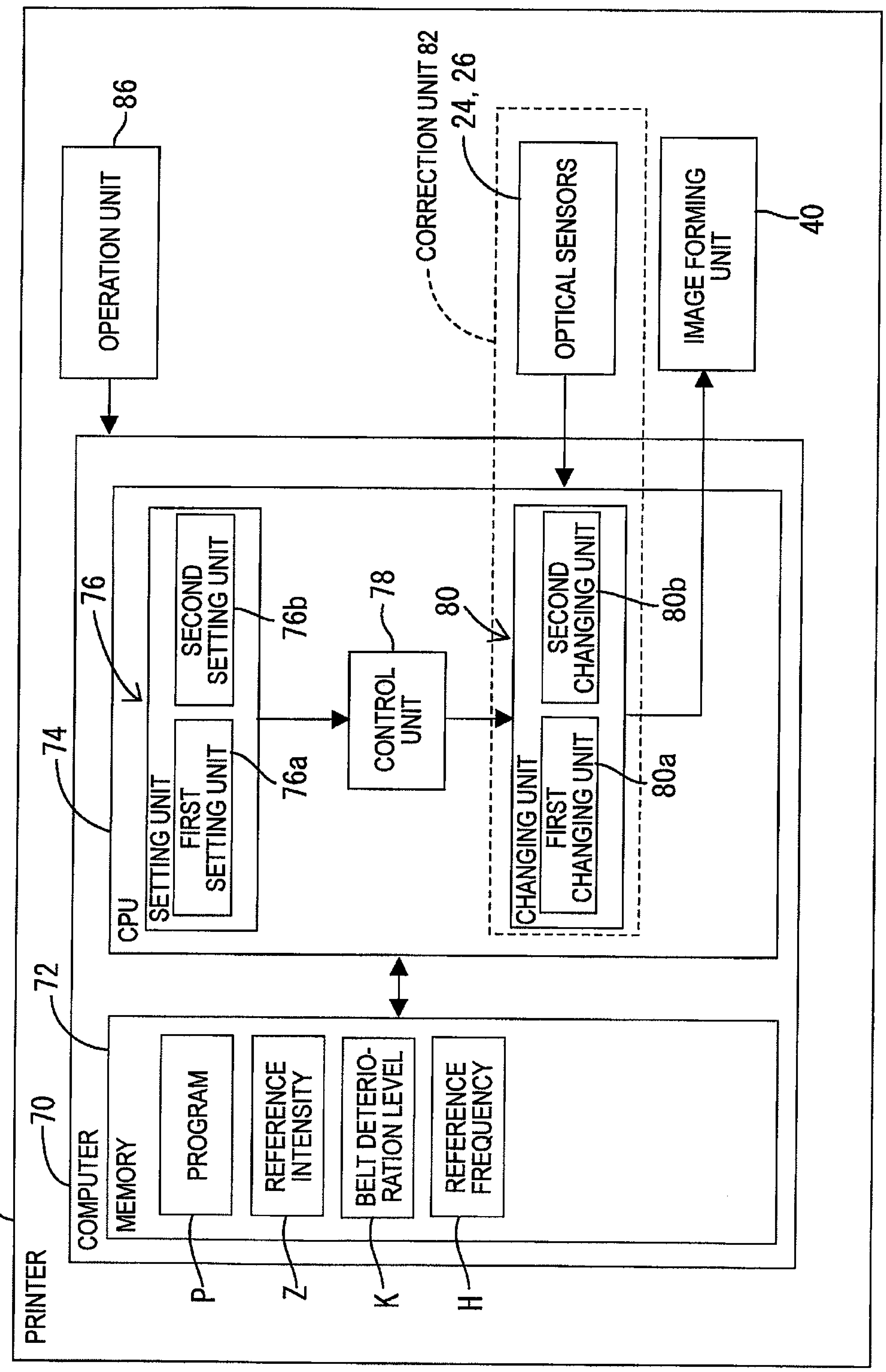
PRINTER
10
COMPUTER
70
MEMORY
72
PROGRAM
P
REFERENCE INTENSITY
Z
BELT DETERIORATION LEVEL
K
REFERENCE FREQUENCY
H
CPU
74
SETTING UNIT
76
FIRST SETTING UNIT
76a
SECOND SETTING UNIT
76b
CONTROL UNIT
78
CHANGING UNIT
80
FIRST CHANGING UNIT
80a
SECOND CHANGING UNIT
80b
CORRECTION UNIT 82
OPTICAL SENSORS
24, 26
OPERATION UNIT
86
IMAGE FORMING UNIT
40

FIG. 3

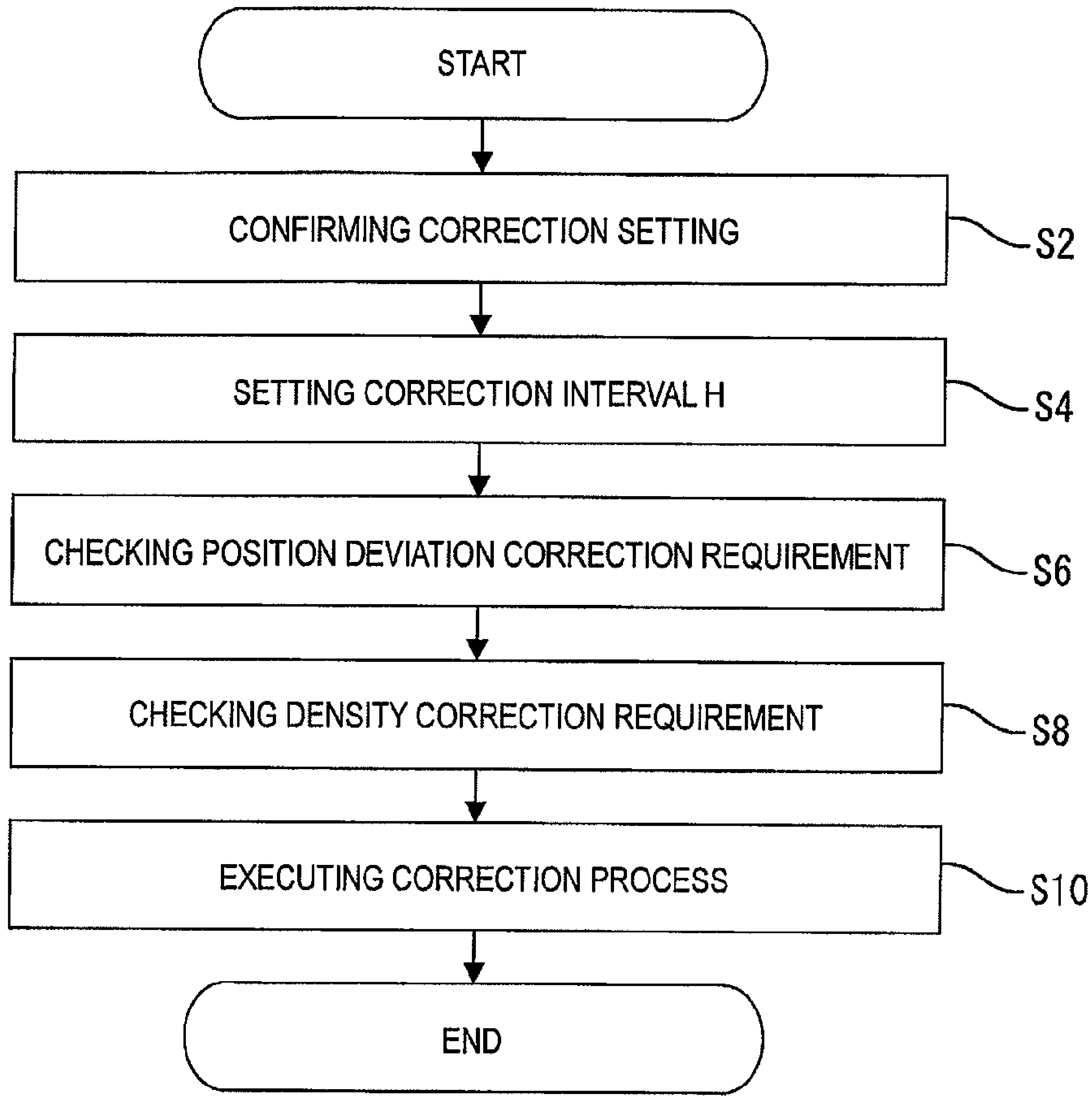
START
CONFIRMING CORRECTION SETTING
S2
SETTING CORRECTION INTERVAL H
S4
CHECKING POSITION DEVIATION CORRECTION REQUIREMENT
S6
CHECKING DENSITY CORRECTION REQUIREMENT
S8
EXECUTING CORRECTION PROCESS
S10
END

FIG. 4

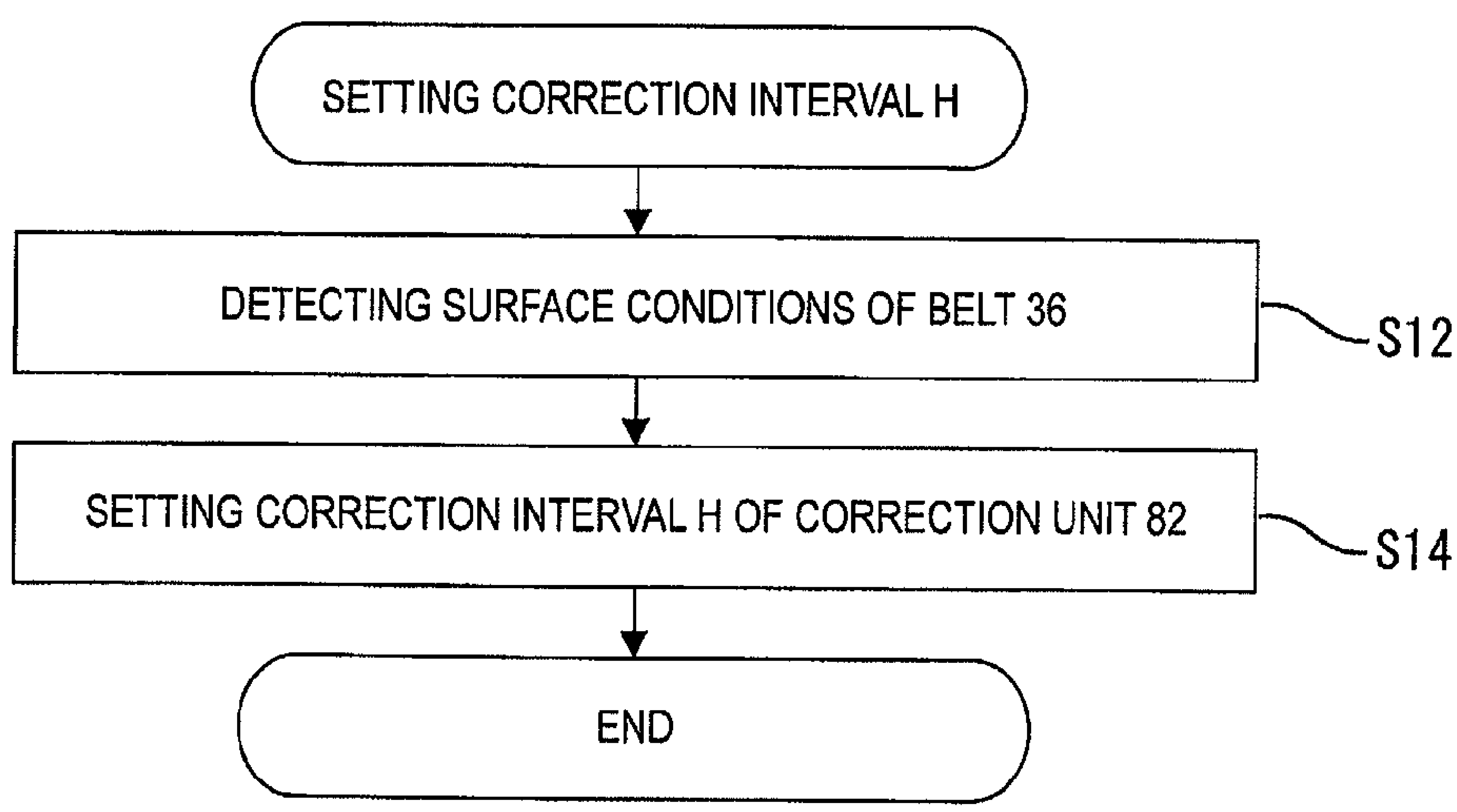
SETTING CORRECTION INTERVAL H
DETECTING SURFACE CONDITIONS OF BELT 36
S12
SETTING CORRECTION INTERVAL H OF CORRECTION UNIT 82
S14
END

FIG. 5

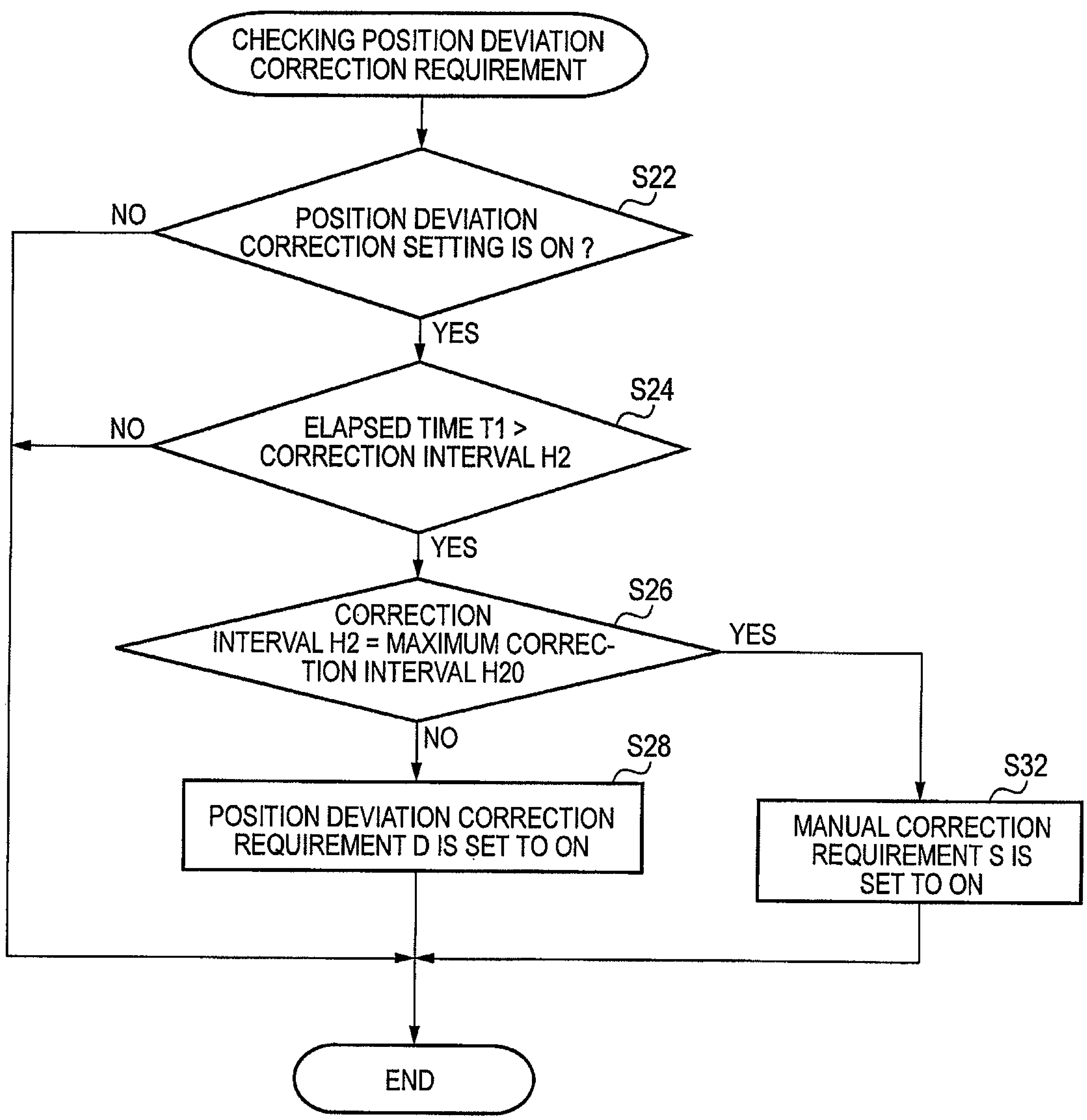
CHECKING POSITION DEVIATION CORRECTION REQUIREMENT
S22
NO
POSITION DEVIATION CORRECTION SETTING IS ON ?
YES
S24
NO
ELAPSED TIME T1 > CORRECTION INTERVAL H2
YES
S26
CORRECTION INTERVAL H2 = MAXIMUM CORRECTION INTERVAL H20
YES
NO
S28
POSITION DEVIATION CORRECTION REQUIREMENT D IS SET TO ON
S32
MANUAL CORRECTION REQUIREMENT S IS SET TO ON
END

FIG. 6

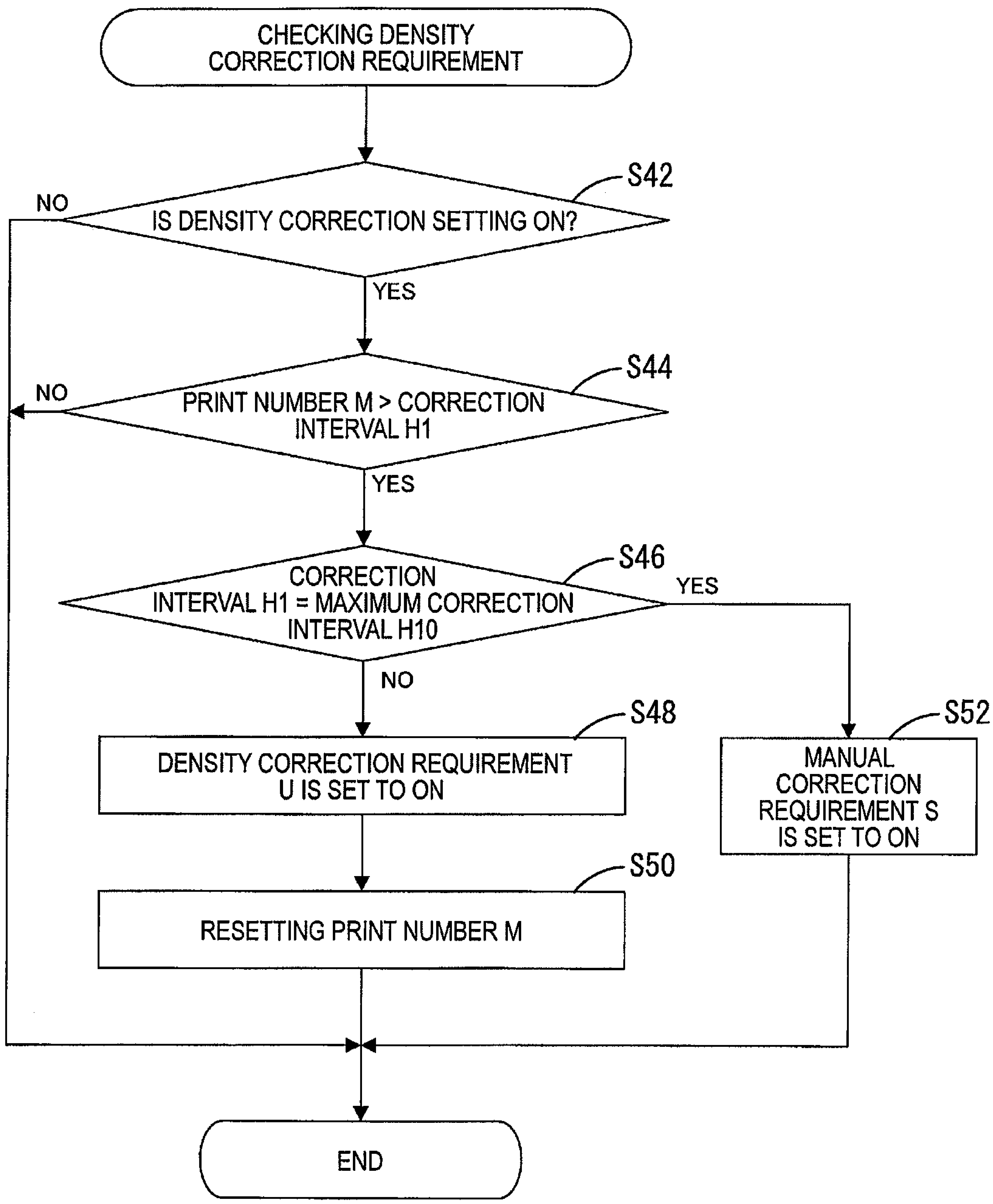
CHECKING DENSITY CORRECTION REQUIREMENT
S42
IS DENSITY CORRECTION SETTING ON?
NO
YES
S44
PRINT NUMBER M > CORRECTION INTERVAL H1
NO
YES
S46
CORRECTION INTERVAL H1 = MAXIMUM CORRECTION INTERVAL H10
YES
NO
S48
DENSITY CORRECTION REQUIREMENT U IS SET TO ON
S52
MANUAL CORRECTION REQUIREMENT S IS SET TO ON
S50
RESETTING PRINT NUMBER M
END

FIG. 7

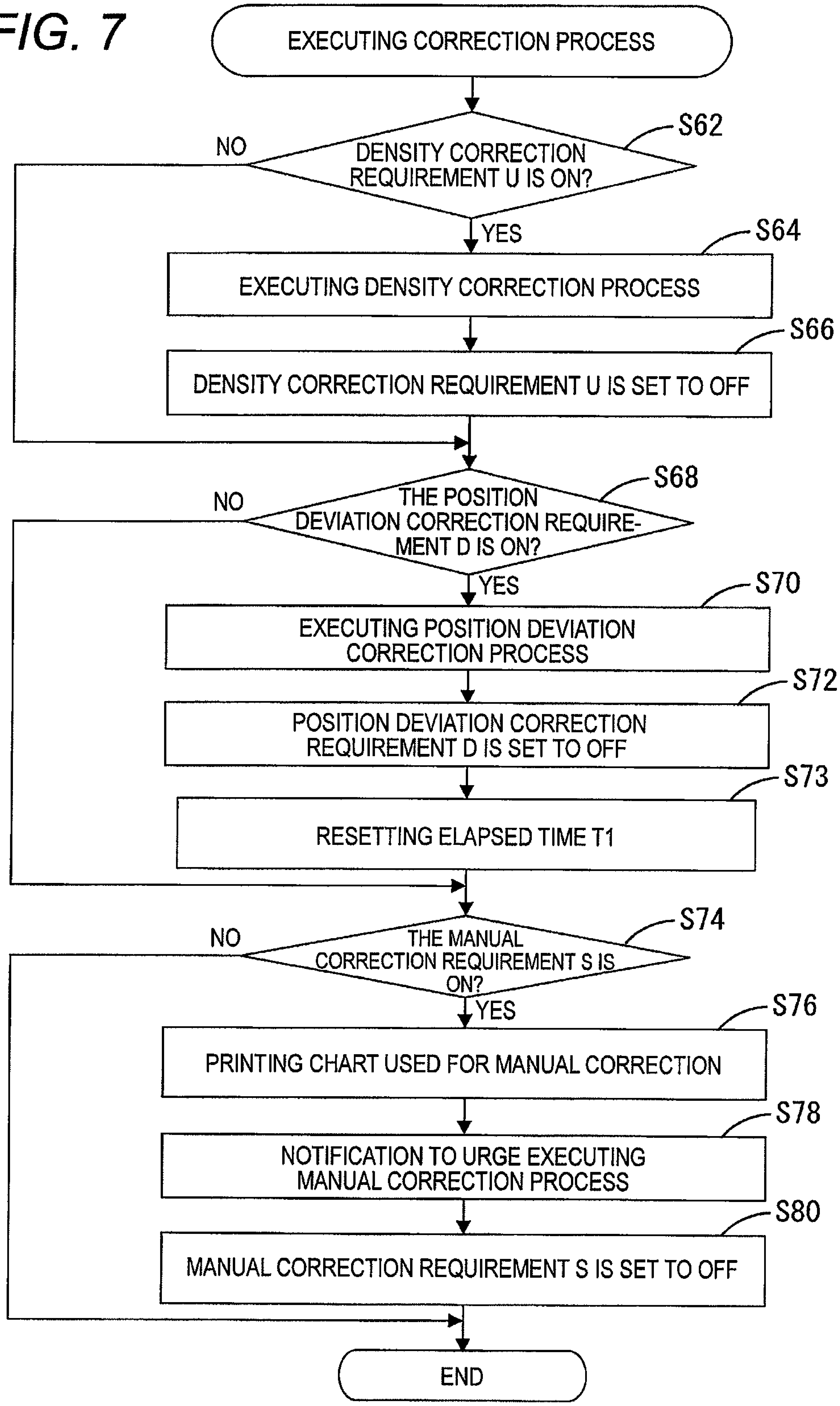
EXECUTING CORRECTION PROCESS
S62
DENSITY CORRECTION REQUIREMENT U IS ON?
NO
YES
S64
EXECUTING DENSITY CORRECTION PROCESS
S66
DENSITY CORRECTION REQUIREMENT U IS SET TO OFF
S68
THE POSITION DEVIATION CORRECTION REQUIRE-MENT D IS ON?
NO
YES
S70
EXECUTING POSITION DEVIATION CORRECTION PROCESS
S72
POSITION DEVIATION CORRECTION REQUIREMENT D IS SET TO OFF
S73
RESETTING ELAPSED TIME T1
S74
THE MANUAL CORRECTION REQUIREMENT S IS ON?
NO
YES
S76
PRINTING CHART USED FOR MANUAL CORRECTION
S78
NOTIFICATION TO URGE EXECUTING MANUAL CORRECTION PROCESS
S80
MANUAL CORRECTION REQUIREMENT S IS SET TO OFF
END

FIG. 8

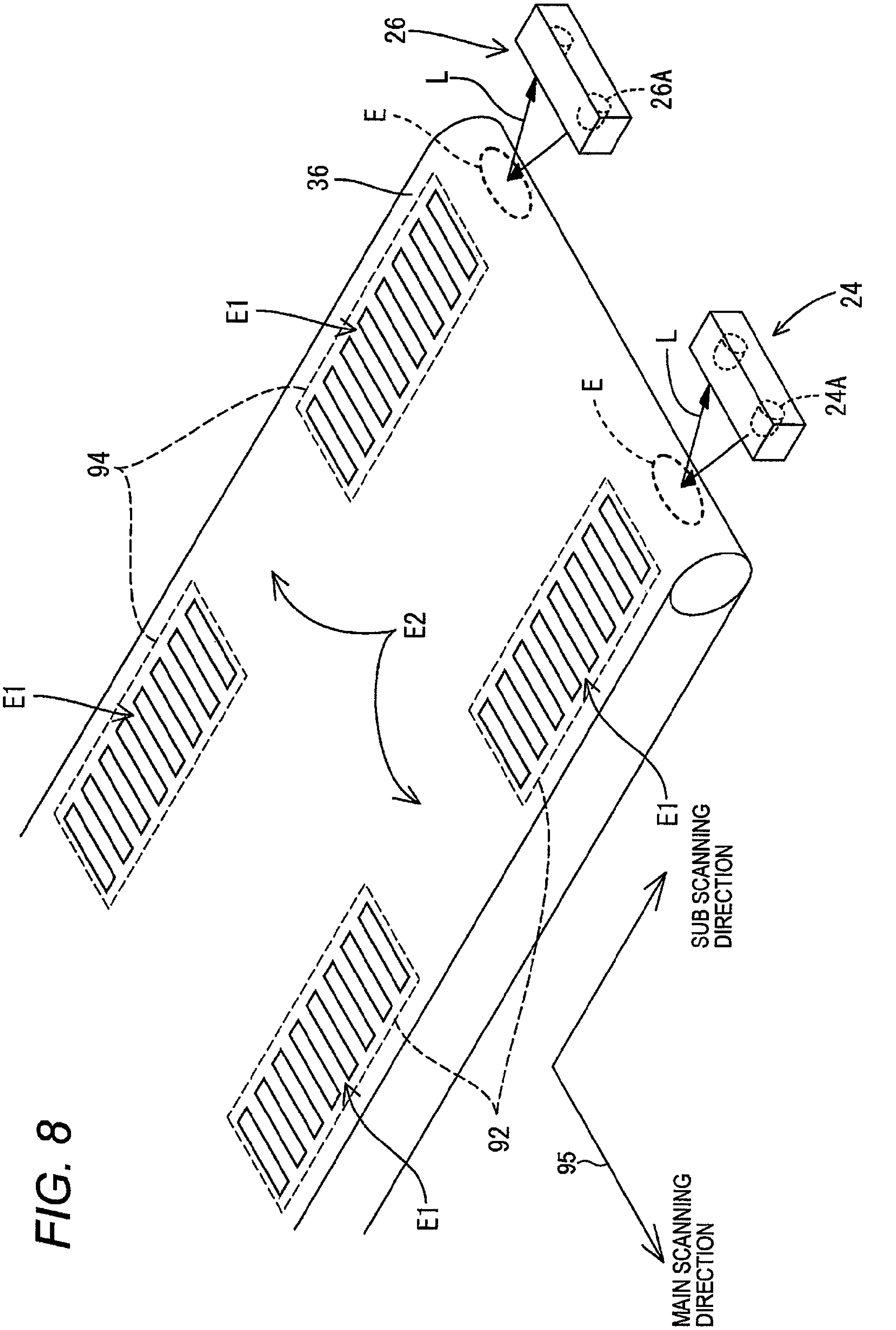
26
L
26A
E
36
E1
24
L
E
24A
94
E2
E1
E1
SUB SCANNING
DIRECTION
92
95
E1
MAIN SCANNING
DIRECTION

FIG. 9

REFERENCE INTENSITY Z	BELT DETERIORATION LEVEL K
$Z3 \leqq Z$	3
$Z2 \leqq Z < Z3$	2
$Z1 \leqq Z < Z2$	1
$Z < Z1$	0

$(Z3 > Z2 > Z1)$

FIG. 10

BELT DETERIORATION LEVEL K	CORRECTION INTERVAL H1	CORRECTION INTERVAL H2
3	150 PAGES	30 MIN
2	300 PAGES	60 MIN
1	500 PAGES	90 MIN
0	1000 PAGES (H10)	120 MIN(H20)

FIG. 11

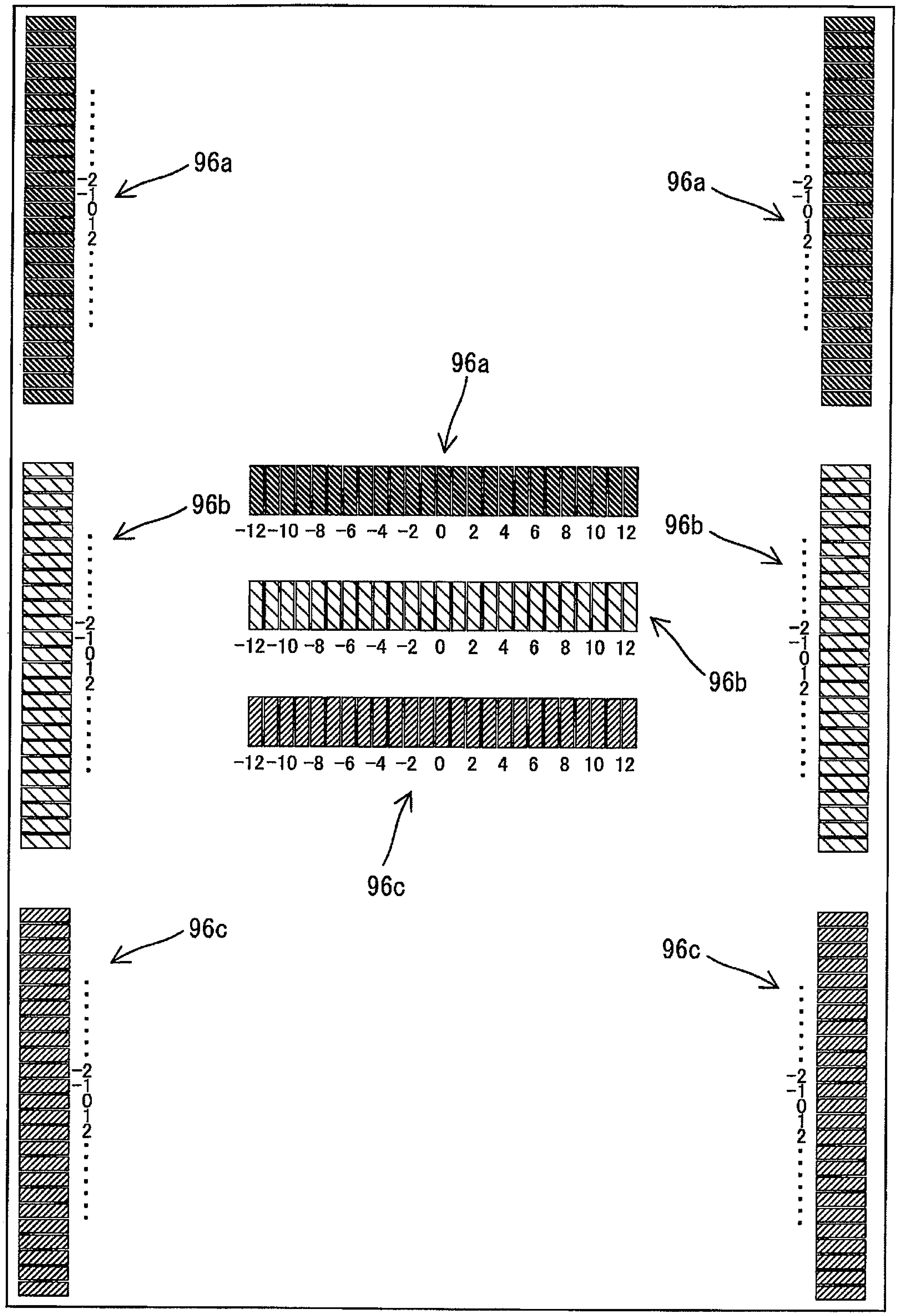

FIG. 12

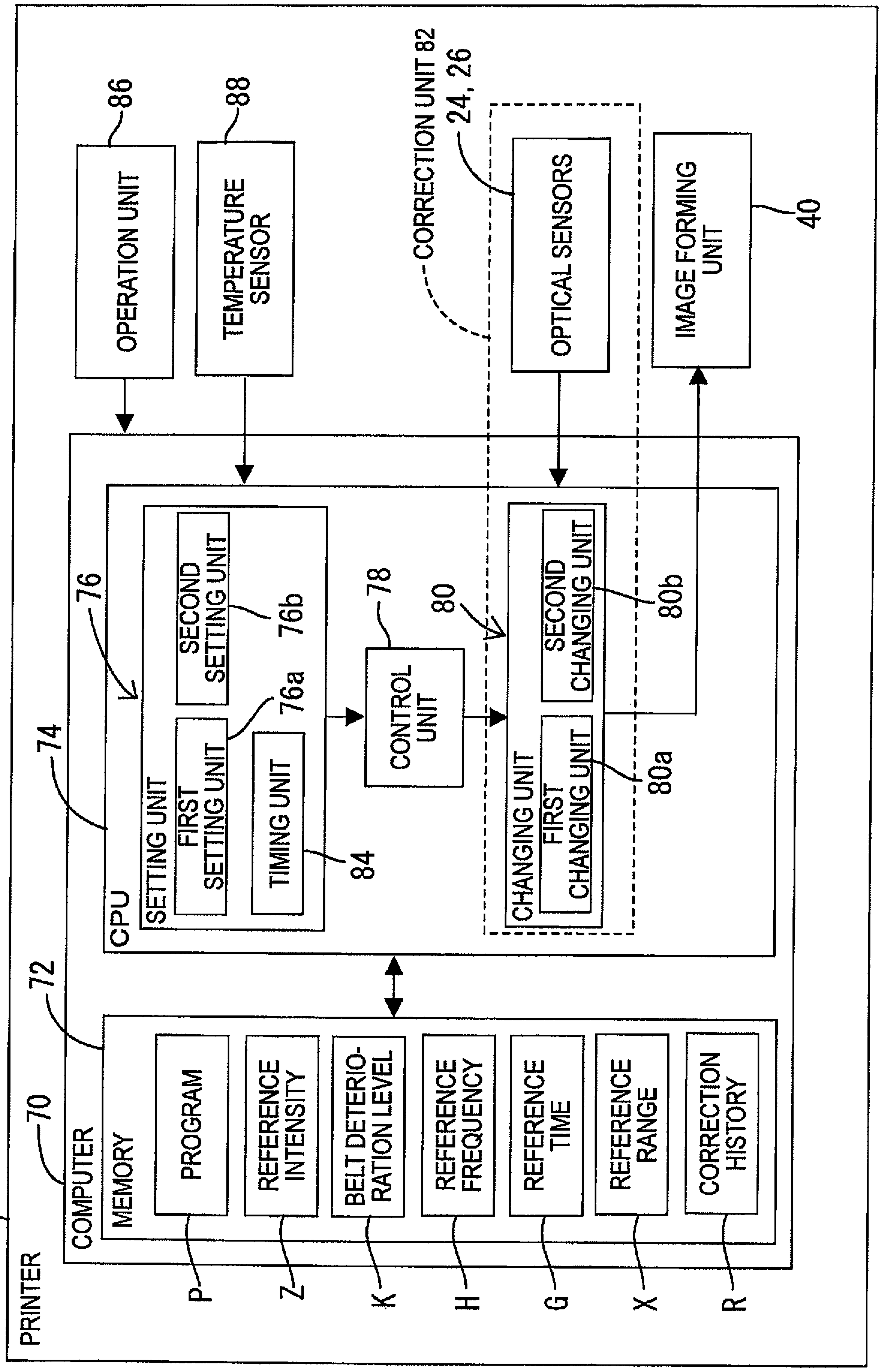
PRINTER
110
COMPUTER
70
MEMORY
72
PROGRAM
P
REFERENCE INTENSITY
Z
BELT DETERIO-RATION LEVEL
K
REFERENCE FREQUENCY
H
REFERENCE TIME
G
REFERENCE RANGE
X
CORRECTION HISTORY
R
CPU
74
SETTING UNIT
76
FIRST SETTING UNIT
76a
SECOND SETTING UNIT
76b
TIMING UNIT
84
CONTROL UNIT
78
CHANGING UNIT
80
FIRST CHANGING UNIT
80a
SECOND CHANGING UNIT
80b
OPERATION UNIT
86
TEMPERATURE SENSOR
88
CORRECTION UNIT 82
OPTICAL SENSORS
24, 26
IMAGE FORMING UNIT
40

FIG. 13

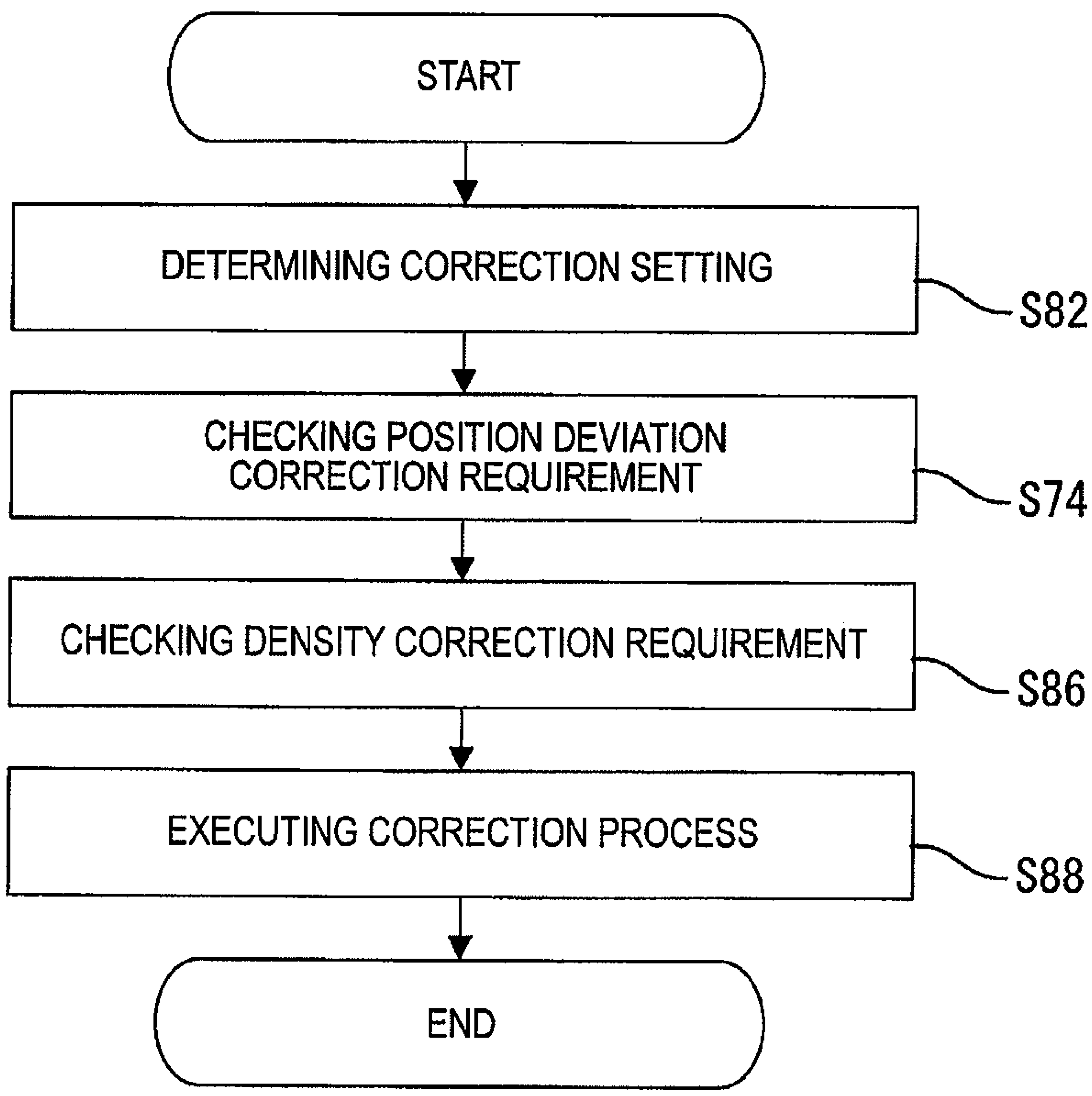
START
DETERMINING CORRECTION SETTING
S82
CHECKING POSITION DEVIATION CORRECTION REQUIREMENT
S74
CHECKING DENSITY CORRECTION REQUIREMENT
S86
EXECUTING CORRECTION PROCESS
S88
END

FIG. 14A

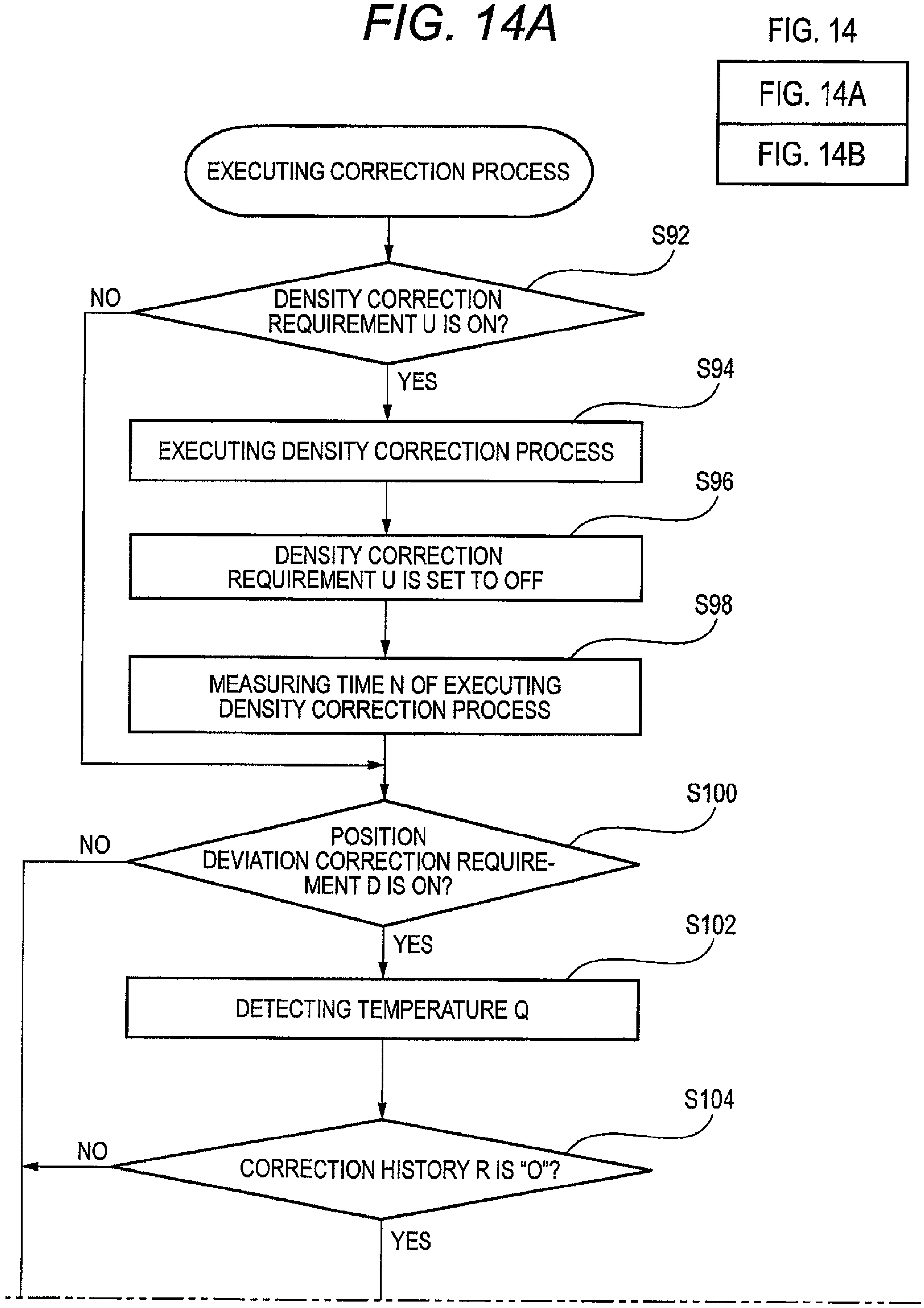
FIG. 14
FIG. 14A
FIG. 14B
EXECUTING CORRECTION PROCESS
S92
NO
DENSITY CORRECTION REQUIREMENT U IS ON?
YES
S94
EXECUTING DENSITY CORRECTION PROCESS
S96
DENSITY CORRECTION REQUIREMENT U IS SET TO OFF
S98
MEASURING TIME N OF EXECUTING DENSITY CORRECTION PROCESS
S100
NO
POSITION DEVIATION CORRECTION REQUIREMENT D IS ON?
YES
S102
DETECTING TEMPERATURE Q
S104
NO
CORRECTION HISTORY R IS "O"?
YES

FIG. 14B

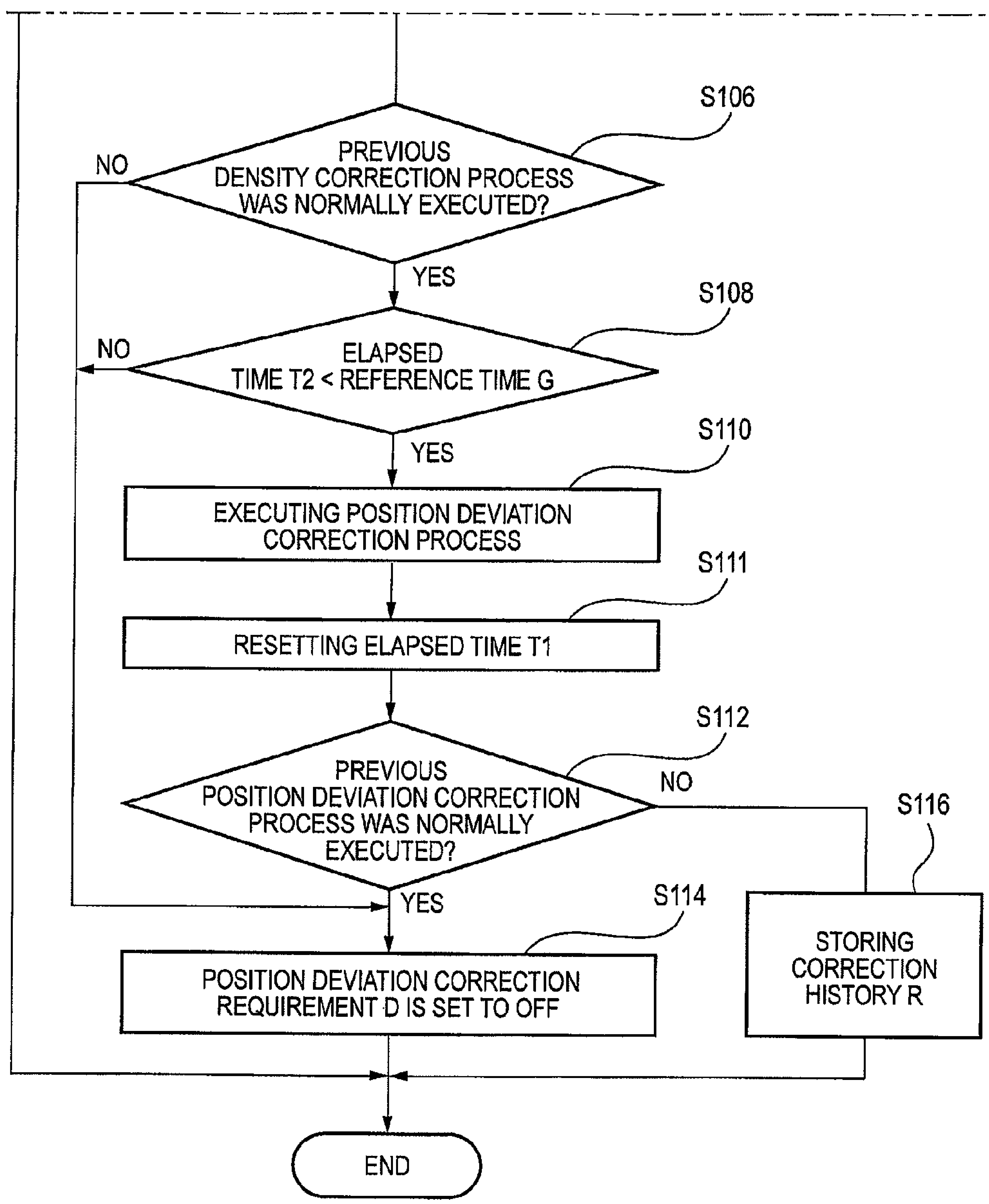
S106
PREVIOUS DENSITY CORRECTION PROCESS WAS NORMALLY EXECUTED?
NO
YES
S108
ELAPSED TIME T2 < REFERENCE TIME G
NO
YES
S110
EXECUTING POSITION DEVIATION CORRECTION PROCESS
S111
RESETTING ELAPSED TIME T1
S112
PREVIOUS POSITION DEVIATION CORRECTION PROCESS WAS NORMALLY EXECUTED?
NO
S116
STORING CORRECTION HISTORY R
YES
S114
POSITION DEVIATION CORRECTION REQUIREMENT D IS SET TO OFF
END

FIG. 15A

REFERENCE RANGE X	CORRECTION HISTORY R
X1	×
X2	○
X3	○
X4	○
X5	○
···	···
Xn−1	○
Xn	×

FIG. 15B

REFERENCE RANGE X	CORRECTION HISTORY R
X1	×
X2	×
X3	○
X4	○
X5	○
···	···
Xn−1	○
Xn	×

IMAGE FORMING APPARATUS AND STORING MEDIUM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority from Japanese Patent Application No. 2010-041908 filed on Feb. 26, 2010, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

Aspects of the present invention relate to an image forming apparatus and a storing medium.

BACKGROUND

Traditionally, an image forming apparatus has been used. The image forming apparatus includes a forming unit, which forms an image on an object by transferring the image to a relatively moving object. In the image forming apparatus, if a position of the image formed on the object by the forming unit is not in conformity with a planned image position, a so-called position deviation occurs. Further, if an area of the image that is formed on the object by the forming unit is not in conformity with a planned image area, a so-called color deviation occurs. Related art discloses a correction process that prevents deterioration of image quality due to the position deviation and the color deviation. In the correction process, the position deviation and the color deviation are prevented by detecting a surface condition of the object, determining a position of the image formed on the object based on the detected result, and then executing the correction process.

SUMMARY

In an image forming apparatus, when the surface conditions of the object deteriorates, or when an inside of the apparatus is hot or humid, probability of a success of a correction process becomes low. In related-art, the correction process was executed at a normal frequency under such conditions by selecting a portion having a relatively good surface condition as a detection area. However, if the correction process is executed at a normal frequency under such conditions, a number of failures of the correction process increase. Thus, detection values that can be used in the correction process are reduced, and an accuracy of the correction process decreases.

Accordingly, it is an aspect of the present invention to provide an image forming apparatus capable of preventing the correction process to be executed at low accuracy.

According to an aspect of the present invention, there is provided an image forming apparatus comprising: a forming unit configured to form an image on a relatively moving object, the image including a mark; a first detection unit configured to detect the mark formed by the forming unit so as to obtain a first detection result; a correction unit configured to execute a correction process in which an image forming condition of the image forming unit is changed based on the first detection result; a setting unit configured to set the correction process not to be executed when a value related to a correction accuracy of the correction unit is lower than a reference value; and a control unit configured to control the correction process based on the setting by the setting unit.

According to another aspect of the present invention, there is provided a computer readable storing medium storing a computer program for causing an image forming apparatus, which includes an image forming unit, to perform a method of: forming an image on a relatively moving object, the image including a mark; detecting the mark so as to obtain a first detection result; executing a correction process in which an image forming condition of the image forming unit is changed based on the first detection result; setting the correction process not to be executed when a value related to a correction accuracy of the correction process is lower than a reference value; and controlling the correction process based on the setting.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a sectional side view of a printer **10**;

FIG. **2** is a block diagram showing a control system of the printer **10**;

FIG. **3** is a flowchart showing a controlling process of the printer **10**;

FIG. **4** is a flowchart showing setting of a correction interval H;

FIG. **5** is a flowchart showing checking of a position deviation correction requirement;

FIG. **6** is a flowchart showing checking of a density correction requirement;

FIG. **7** is a flowchart showing a correction process;

FIG. **8** is a perspective view of optical sensors **24**, **26** and a belt **36**;

FIG. **9** is a table showing a relationship of a reference intensity Z and a belt deterioration level K;

FIG. **10** is a table showing a relationship of the belt deterioration level K and the correction interval H;

FIG. **11** is a chart used for manual correction;

FIG. **12** is a block diagram showing a control system of a printer **110**;

FIG. **13** is a flowchart showing a correction process of the printer **110**;

FIG. **14** (**14**A, **14**B) is a flowchart showing a correction process; and

FIG. **15**A is a table showing a relationship of a reference range X and a correction history R; and

FIG. **15**B is a table showing the relationship of the reference range X and the correction history R.

DETAILED DESCRIPTION

First Exemplary Embodiment

The first exemplary embodiment of the invention will be described with reference to FIGS. **1** to **11**.

1. Overall Configuration of a Printer

FIG. **1** is a sectional side view showing schematic configuration of a printer **10** of the first exemplary embodiment. As shown in FIG. **1**, the printer **10** is a color laser printer that uses toner of four colors (yellow, magenta, cyan and black) and forms a color image by using a direct transfer tandem method. The printer **10** is formed in a casing **12**. A feeding tray **14** is provided at a bottom inside of the casing **12**. A sheet material **16** such as a sheet is stacked on the feeding tray **14**.

The sheet material **16** is supplied to the feeding tray **14** by a user, and after the sheet material **16** is stored in the casing **12**, the sheet material **16** is lifted up by a pressing plate **18**, and then the sheet materials **16** is pressed to a pickup roller **20**. The sheet material **16** is transferred to a registration roller **22** by rotating the pickup roller **20**. After an inclination correction of the sheet material **16** is made by the registration roller **22**, the sheet material **16** is sent to a belt unit **30**.

The belt unit **30** includes a pair of support rollers **32** and **34**, a belt **36** and multiple transfer rollers **38**. The belt **36** is constructed between the support rollers **32** and **34**. Ends of the belt **36** are connected to form a ring. The transfer rollers **38** are provided inside the ring-shaped belt **36** at equal intervals. The support rollers **32** and **34** are rotated counterclockwise by a motor that is not shown in the figure, and the belt **36** moves accordingly. The sheet material **16** that has been sent to the belt unit **30** moves together with the belt according to the rotation of the belt **36**.

An image forming unit **40** is provided upper to the belt unit **30**. The image forming unit **40** includes a scanner unit **42** and a process unit **44**. The scanner unit **42** (process unit **44**) contains four scanner units **42** (process units **44**) corresponding to the toner of four colors. When specifying each of the scanner units **42** (process unit **44**), one or two alphabets (yellow: Y, magenta: M, cyan: C and black: BK) identifying each color are provided after reference numbers. Each process unit **44** is arranged at equal intervals at a position that corresponds to each transfer roller **38** of the belt unit **30**. Each scanner unit **42** is arranged above each of the corresponding process units **44**.

The scanner units **42** control each laser emitting units **46** based on each image data sent from a computer **70** (FIG. **2**), to irradiate laser light L to surfaces of each photosensitive drums **50** provided on the corresponding process unit **44**.

Each process unit **44** includes a charger **48**, a photosensitive drum **50** and a developing cartridge **52**. The charger **48** charges the surface of the photosensitive drum **50** to be uniformly positive. A toner storage chamber **54** and a developing roller **56** are provided in the developing cartridge **52**. The toner storage chamber **54** of the developing cartridge **52** is filled with toner, and the toner in the toner storage chamber **54** is supplied to the developing roller **56**.

In the image forming unit **40**, when an image is formed on the sheet material **16** or the belt **36**, the charger **48** charges the surface of the photosensitive drum **50** to be positive. Next, the laser light L from the laser emitting unit **46** of the scanner **42** is irradiated to the photosensitive drum **50**. Thus, an electrostatic latent image corresponding to the image to be formed is formed on the surface of the photosensitive drum **50**.

When the photosensitive drum **50** on which the electrostatic latent image was formed passes through a toner supply position F between the photosensitive drum **50** and the developing roller **56**, the toner carried on the developing roller **56** is supplied to the surface of the photosensitive drum **50** on which the electrostatic latent image was formed. The toner images of each color are formed on the corresponding photosensitive drum **50** thereby.

When the photosensitive drum **50** on which the toner image was formed passes through a transfer position I between the photosensitive drum **50** and the transfer roller **38**, the toner image of the photosensitive drum **50** is transferred to the sheet material **16** (belt **36**) that passes the transfer position I, by applying negative transfer bias to the transfer roller **38**. As a result, an image is formed on the sheet material **16**. In addition, batches **92** and **94** (see FIG. **8**) are formed on the belt **36**. Each color image is successively formed on the sheet material **16** (belt **36**) with the movement of the belt **36**. The image formed on the sheet material **16** is sent to a fixing unit **58** and fixed, and is discharged to a discharging tray **62** formed outside the casing **12** by a discharging roller **60**.

Optical sensors **24** and **26** (e.g., first detection units, second detection units, particular detection units) and a clearing roller **28** are provided lower to the belt unit **30**. The optical sensors **24** and **26** can detect the batches **92** and **94** formed on the belt **36**. As shown in FIG. **8**, the optical sensors **24** and **26** are reflective optical sensors which are arranged side by side in a direction orthogonal to the movement direction of the belt **36**, shown by an arrow **95**.

The cleaning roller **28** removes toner and paper dust attached to the belt **36**. Here, the "the attached toner" includes the batches **92** and **94** intentionally formed on the belt **36** as well as the toner unintentionally attached to the belt.

2. Electrical Configuration of the Printer

FIG. **2** schematically shows a control system of the printer **10**. The printer **10** further includes an operation unit **86** and a computer **70**. The printer **10** is controlled by the computer **70**. The operation unit **86** includes multiple buttons, through which operations such as power ON/OFF and printing start instruction, and correction setting can be input by a user. The computer **70** includes a memory **72** and a Central Processing Unit (CPU) **74**. Various programs P are stored in the memory **72** to control operations of the printer **10**. The CPU **74** executes various functions of the printer **10** according to the program P which is read from the memory **72**.

In the printer **10**, four scanner units **42** (process units **44**), corresponding to the toner of four colors, are provided to the image forming unit **40**. When image forming conditions, such as density and position of an image formed on the sheet material **16** by each scanner unit **42** (process unit **44**), are not adjusted, image quality of the images formed on the sheet material **16** deteriorates. Therefore, the program P is stored in the memory **72** of the computer **70** to correct the image forming condition of each scanner unit **42** (process unit **44**), and the program P is executed under certain conditions. At this time, as shown in FIG. **2**, the CPU **74** functions as a setting unit **76** and a control unit **78**. In addition, the CPU **74** functions as a changing unit **80**. The CPU **74** that functions as the changing unit **80** functions as a correction unit **82** by operating together with the optical sensors **24** and **26**. The correction unit **82** corrects the image forming condition of each scanner unit **42** (process unit **44**) by controlling the image forming unit **40** and using a reference intensity Z (an example of reference conditions), a belt deterioration level K (an example of reference value) and a correction interval H (an example of reference frequency) stored in the memory **72**.

3. Correction Process of the Formed Image

With reference to FIG. **3**, the correction process to the image forming condition of the printer **10** will be described. The correction process is repeatedly executed after the power is supplied to the printer **10**.

When the correction process starts, the CPU **74** confirms the correction setting input by a user (S**2**). Next, the CPU **74** sets the correction interval H of the correction unit **82** (S**4**).

In S**4**, the CPU **74** functions as the setting unit **76**, and executes the following processes shown in FIG. **4**.

The CPU **74** controls the optical sensors **24** and **26**, and detects the surface condition of the belt **36** (S**12**). In particular, the surface condition of the belt **36** is detected by the optical sensors **24** and **26** with the movement of the belt **36**. As shown in FIG. **8**, the optical sensors **24** and **26** irradiates the light from light sources **24***a* and **26***a* inside the optical sensors **24** and **26** to the detected area E on the surface of the belt **36**, and measures an intensity of light L reflected from the belt **36**, and the measurement result (an example of a second detection result) is transmitted to the CPU **74**.

Next, the CPU **74** selects the belt deterioration level K based on the measurement result (S**14**). In this case, the belt deterioration level K may be selected by using an average value of the measurement result for one circuit of the belt, which has been calculated, or by using a lowest intensity among the measurement result of one circuit of the belt. The CPU **74** compares the measurement result transmitted from the optical sensors **24** and **26** with the reference intensity Z stored in the memory **72**. As shown in FIG. **9**, the reference intensity Z is stored in the memory **72** in correspondence with the belt deterioration level K. The belt deterioration level K set in the memory **72** decreases as the reference intensity Z decreases. When the belt **36** deteriorates, and the measurement result measured by the optical sensors **24** and **26** is low, the belt deterioration level K is lower than the original state (belt deterioration level K is 3). The CPU **74** determines the reference intensity Z based on the measurement result, and selects the belt deterioration level K corresponding to the reference intensity Z.

Next, the CPU **76** determines the correction interval H based on the selected belt deterioration level K, and sets the correction interval H of the correction unit **82** (S**14**). As shown in FIG. **10**, the correction interval H corresponding to the belt deterioration level K is set in the memory **72**. In the memory **72**, the correction interval H is set so as to increase as the belt deterioration level K decreases, so that the correction frequency decreases. In other words, the correction process is set so as not to be executed as the belt deterioration level K decreases. The CPU **74** determines the correction interval H corresponding to the selected belt deterioration level K, and sets it as the correction interval H of the correction unit **82**.

In the first exemplary embodiment, the correction interval H**1** of the density deviation correction by the first correction unit (that is, the first changing unit **80***a* and the optical sensors **24** and **26**), which is set by the first setting unit **76***a*, is set by using the print number of the sheet material **16** since the previous correction process was executed. In addition, the correction interval H**2** of the position deviation correction by the second correction unit (that is, the second changing unit **80***b* and the optical sensors **24** and **26**), which is set by the second setting unit **76***b*, is set by using the elapsed time since the previous position deviation correction was executed. In the first exemplary embodiment, in order to execute the correction process according to each image forming condition, the correction interval H is set under separate conditions by the first correction unit and the second correction unit. When the belt **36** deteriorates and the measurement result measured by the optical sensors **24** and **26** decreases, the correction interval H**1** is set larger than that of the original state (correction interval H**1**: 30 min, correction interval H**2**: 150 pages). That is, the correction interval H**1** is set so that the correction frequency decreases.

Next, the CPU **74** executes a checking process of the position deviation correction requirement (S**6**). The CPU **74** functions as the control unit **78** in S**6**, and executes the following processes shown in FIG. **5**.

The CPU **74** confirms the position correction setting confirmed in S**2** (S**22**). An elapsed time T**1**, which is a time elapsed since the previous position deviation correction was executed, has been measured by the CPU **74**, and when the position deviation correction setting is ON (S**22** is YES), the CPU **74** compares the elapsed time T**1** and the correction interval H**2** (S**24**). When the elapsed time T**1** is smaller than the correction interval H**2** (S**24** is NO), the CPU **74** terminates the checking process of the position deviation correction requirement. When the elapsed time T**1** exceeds the correction interval H**2** (S**24** is YES), the CPU **74** determines whether the correction interval H**2** is equal to the maximum correction interval H**20** (120 minutes) (S**26**). When the correction interval H**2** is equal to the maximum correction interval H**20** (S**26** is YES), the CPU **74** sets the manual correction requirement S to ON (S**32**). When the correction interval H**2** is smaller than the maximum correction interval H**20** (S**26** is NO), the CPU **74** sets the position deviation correction requirement D to ON, and terminates the checking process of the position deviation correction requirement (S**28**). Meanwhile, when the position deviation correction setting is OFF (S**22** is NO), the CPU **74** terminates the checking process of the position deviation correction requirement.

Next, the CPU **74** executes a checking process of the density correction requirement (S**8**). The CPU **74** functions as the control unit **78** in S**8**, and executes the following processes shown in FIG. **6**.

The CPU **74** confirms the density correction setting confirmed in S**2** (S**42**). A print number M of the printer **10**, which is a number of printing since a previous density correction was executed, has been measured by the CPU **74**, and when the density correction setting is ON (S**42** is YES), the CPU **74** compares the print number M and the correction interval H**1** (S**44**). When the print number M is smaller than the correction interval H**1** (S**44** is NO), the CPU **74** terminates the checking process of the density correction requirement. When the print number M exceeds the correction interval H**1** (S**44** is YES), the CPU **74** determines whether the correction interval H**1** is equal to the maximum correction interval H**10** (300 pages) (S**46**). When the correction interval H**1** is equal to the maximum correction interval H**10** (S**46** is YES), and the manual correction requirement S is not set to ON in the checking process of the position deviation correction requirement, the CPU **74** sets the manual correction requirement S to ON (S**52**). When the correction interval H**1** is smaller than the maximum correction interval H**10** (S**46** is NO), the CPU **74** sets the density correction requirement to ON, and resets the print number M (S**50**), and terminates the checking process of the density correction requirement. Meanwhile, when the position deviation correction setting is OFF (S**42** is NO), the CPU **74** terminates the checking process of the position deviation correction requirement.

When the correction interval H**1** is equal to the maximum correction interval H**10**, or the correction interval H**2** is equal to the maximum correction interval H**20**, the CPU **74** sets the manual correction requirement S to ON (S**32**). As shown in FIG. **10**, when the correction interval H**1** is equal to the maximum correction interval H**10** (or the correction interval H**2** is equal to the maximum correction interval H**20**), the belt deterioration level K is small, and the probability that the belt is deteriorated is high. In the first exemplary embodiment, in this kind of case, by requiring that the correction process be executed manually by a user and preventing the correction process by the correction unit **82**, the execution of the correction process at low accuracy can be prevented.

Next, the CPU **74** executes the correction process (S**10**). The CPU **74** functions as the changing unit **80** (correction unit **82**) in S**10**, and executes the following processes shown in FIG. **7**.

The CPU **74** executes the density correction process prior to the position deviation correction process. In the position deviation correction process, in order to exactly detect the positions of the batches **92** and **94** formed on the belt **36** by using the optical sensors **24** and **26**, it is necessary to previously form the batches **92** and **94** in density which is higher than a predetermined density. The execution of the position deviation correction process in low accuracy can be prevented by executing the density correction process prior to the position deviation correction process.

When the CPU **74** executes the density correction process, the density correction requirement U is confirmed first (S**62**). When the density correction requirement U is ON (S**62** is YES), the CPU **74** executes the density correction process (S**64**). In the density correction process, as shown in FIG. **8**, the CPU **74** controls the image forming unit **40** so as to form the batches **92** and **94** to be used for density correction on the surface of the belt **36**. The CPU **74** controls the optical sensors **24** and **26** to detect the reflected light intensity of the belt **36** of an area E**1** in which the batches **92** and **94** are formed. The CPU **74** changes the image forming conditions of the image forming unit **40** so that an amplitude of an area that the detected reflected light intensity (an example of the first detection result) exceeds a predetermined threshold value matches a reference amplitude. After the density correction process is executed, the density correction requirement U is turned OFF (S**66**). Meanwhile, when the density correction requirement U is OFF (S **62** is NO), the density correction process is not executed.

Next, the CPU **74** executes a position deviation correction process. When the CPU **74** executes the position deviation correction process, the position deviation correction requirement D is confirmed (S**68**). When the position deviation correction requirement D is ON (S**68** is YES), the CPU **74** executes the position deviation correction process (S**70**). Similar to the density correction process, the CPU **74** detects the reflected light intensity of the belt **36** of the area E**1** in which the batches **92** and **94** are formed. The CPU **74** changes the image forming conditions of the image forming unit **40** so that a position of an area that the detected reflected light intensity exceeds a predetermined threshold value matches a reference position in the moving direction of the belt **36**. After the position deviation correction process is executed, the position deviation correction requirement D is turned OFF (S**72**). After that, the elapsed time T**1** is reset, and then, the elapsed time T**1** starts to be counted again (S**73**). Meanwhile, when the position deviation correction requirement D is OFF (S**68** is NO), the position deviation correction process is not executed.

Next, the CPU **74** executes a manual correction process. When the CPU **74** executes the manual correction process, the manual correction requirement S is confirmed (S**74**). When the manual correction requirement S is ON (S **74** is YES), the CPU **74** controls the image forming unit **40** and prints a chart used for manual correction shown in FIG. **11** on the sheet material **16** (S**76**). FIG. **11** is a chart used for manual correction of color deviation correction.

As shown in FIG. **11**, multiple identification marks **96** are described in the chart used for manual correction to correct manually the image forming conditions (density, position deviation) of the image forming unit **40**. A first identification mark **96***a* adjusting the image forming condition between black and magenta, a second identification mark **96***b* adjusting the image forming condition between black and cyan, and a third identification mark **96***c* adjusting the image forming condition between black and yellow are formed in each identification mark **96**. Each identification mark **96***a*, **96***b* and **96***c* are arranged on left and right sides of a short edge of the sheet material **16** (corresponding to a sub-scanning direction of the belt **36**) and in the center of the sheet material **16**.

Next, the CPU **74** urges the user to execute the manual correction process according to a notification by a notification unit provided to the operation unit **86** (S**78**). Even when the correction accuracy of the correction process executed by the correction unit **82** is evaluated to be low, a certain degree of correction accuracy can be ensured by manually executing the correction process by a user. A user that notices the printing of the chart used for the manual correction and the notification by the notification unit inputs values that are related to the position deviation corresponding to each identification mark **96***a*, **96***b* and **96***c*. According to the value input based on the identification marks **96***a*, **96***b* and **96***c* that are arranged on the left and right sides, the CPU **74** corrects the image forming

conditions of the image forming unit **40** in the main scanning direction of the belt **36**. In addition, according to the value input based on each identification mark **96***a*, **96***b* and **96***c* that are arranged in the center, the CPU **74** corrects the image forming conditions of the image forming unit **40** in the sub-scanning direction of the belt **36**. After the above processes have been executed, the CPU **47** sets the manual correction requirement S as OFF (S**80**). Meanwhile, the density correction can be corrected manually by, printing a chart to be used for manual correction of the density correction, which is different from that of FIG. **11**, inputting a density deviation value visually determined by the user, and executing the density correction based on the input density deviation value.

In the first exemplary embodiment, when the belt **36** deteriorates, and the measurement result measured by the optical sensors **24** and **26** is low, the correction frequency is set to be low. In other words, the correction process is set not to be executed. According to the first exemplary embodiment, even if the correction accuracy of the correction unit **82** is evaluated to be low, the number of failures of the correction process can be low, and the execution of the correction process in low accuracy can be prevented.

Second Exemplary Embodiment

The second exemplary embodiment of the invention will be described with reference to FIGS. **12** to **15**.

FIG. **12** schematically shows a control system of a printer **110** of the second exemplary embodiment. The printer **110** includes a temperature sensor **88** (an example of the third detection unit) that detects a temperature Q (an example of the third detection result) inside the printer **110**. The CPU **74** includes a timing unit **84** to measure the time N during which the density correction process is executed. Reference time G, which is a reference of the elapsed time T**2** (an example of the measuring time) from the execution time N of the density correction process, is stored in the memory **72**. In addition, as shown in FIG. **15***a*, a reference range X, which is a reference of the temperature Q detected by the temperature sensor **88**, is stored in the memory **72** in correspondence with a correction history R of the position deviation correction process of the printer **110**. The correction history R is a record showing whether the correction process was normally executed in the printer **110**. "The correction process was not normally executed" means that, for example, the amount of data that can be used by the correction process among the amount of data detected by using the batches **92** and **94** is not enough, or the correction process was interrupted. For the reference range X and the correction history R that are stored as to correspond to each other, for example, an initial value "O", showing that the correction process can be normally executed, is stored in the correction history R corresponding to all the reference ranges X prepared by printer manufactures. When the correction process is executed, and the correction process is not executed normally, "X" is stored in the correction history corresponding to the temperature when the correction process is executed. As shown in the reference range X**2**, when the correction process executed for the reference range X**2** is normally executed until now, "O" is stored in the correction history R corresponding to the reference range X**2**. On the other hand, as shown in the reference range X**1**, when the correction process executed for the reference range X**1** is not normally executed until now, "X" is stored in the correction history R corresponding to the reference range X**1**.

With reference to FIG. **13**, a correction process of the image forming condition of the printer **110** will be described.

When the correction process starts, the CPU **74** confirms the correction setting input by a user (S**82**). Next, the CPU **74** executes the checking process of the position deviation correction requirement (S**84**) and the checking process of the density correction requirement (S**86**) without setting the correction interval H of the correction unit **82**, which is different from the first exemplary embodiment 1. The processes of S**84** and S**86** are same as the processes described in the first exemplary embodiment by using the same names, and repeated explanation is omitted.

Next, the CPU **74** executes the correction process (S**88**). The CPU **74** function as the changing unit **80** (correction unit **82**) in S**88**, and executes the following processes shown in FIG. **14** (**14**A, **14**B).

The CPU **74** first executes the density correction process. When the density correction requirement is ON (S**92** is YES), the CPU **74** executes the density correction process (S**94**).

In the second exemplary embodiment, when the density correction process is executed, the correction interval H of the correction unit **82** is set at the same time. In other words, as shown in FIG. **8**, when the CPU **74** detects the reflected light intensity of the belt **36** of the area E**1** in which the batches **92** and **94** are formed, the CPU **74** simultaneously detects the reflected light intensity of the belt **36** of an area E**2** in which the batches **92** and **94** are not formed. The CPU **74** uses the reflected light intensity of the belt **36** detected from the area E**1** in which the batches **92** and **94** are formed to execute the density correction process. In addition, the CPU **74** uses the reflected light intensity of the belt **36** detected from the area E**2** in which the batches **92** and **94** are not formed to set the correction interval H (for the first correction interval H**1**, the correction interval H**1** of the density correction process executed subsequently). The detection of the reflected light intensity of the belt **36** which is necessary for the density correction process, and the detection of the reflected light intensity of the belt **36** which is necessary for the setting of the correction interval H can be executed at the same time, so that time necessary for the correction process is reduced. In addition, for the density correction process and the setting process of the correction interval H, the processes are same as the processes described in the first exemplary embodiment by using the same names, and repeated explanation is omitted.

After the density correction process is executed, the CPU **74** sets the density correction requirement U to OFF (S**96**), and the time N during which the density correction process is executed is measured (S**98**). Meanwhile, when the density correction requirement U is OFF (S**92** is NO), the density correction process is terminated.

Next, the CPU **74** executes the position deviation correction process. The CPU **74** confirms the position deviation correction requirement D (S**100**). When the position deviation correction requirement D is ON (S**100** is YES), the CPU **74** executes the processes described hereinafter. Meanwhile, when the position deviation correction requirement D is OFF (S**100** is NO), the CPU **74** terminates the position correction process. When the position deviation correction requirement D is ON (S**100** is YES), the CPU **74** controls the temperature sensor **88** to detect the temperature Q inside the printer (S**102**). The CPU **74** compares the detected temperature Q with the reference range X stored in the memory **72** (S**104**). When the detected temperature Q is within the reference range X corresponding to the correction history R showing "O" (S**104** is YES), the CPU **74** proceeds to the next process (S**106**).

On the other hand, when the detected temperature Q is within the reference range X corresponding to the correction history R showing "X" (S**104** is NO), the CPU **74** terminates the position deviation correction process without setting the position deviation correction requirement D to OFF. In the second exemplary embodiment, when the correction history R is "X", the position deviation correction process is not executed. When the correction history R is "X", the execution of the position deviation correction process in low accuracy can be prevented by not executing the correction process when the correction process may fail. In the second exemplary embodiment, by not setting the position deviation correction requirement D to OFF in the above-described case, the position deviation correction requirement D is maintained as ON, until the detected temperature Q in the subsequent correction process changes to a temperature of the reference range X corresponding to a correction history R showing "O". Thus, when the detected temperature Q changes to a temperature within the reference range X corresponding to the correction history R showing "O", the position deviation correction process is definitely executed.

The CPU **74** stores the result of the previously executed density correction process, and proceeds to execute the next process (S**108**) when the previously executed density correction process is normally executed (S**106** is YES).

Meanwhile, when the previously executed density correction process is not normally executed (S**106** is NO), the CPU **74** sets the position deviation correction requirement to OFF (S**114**), and terminates the position deviation correction process. When the previously executed density correction process executed is not normally executed, the probability that, the position deviation correction process executed by the same procedure will not be normally executed, is high. By not executing the position deviation correction process when the previously executed density correction process is not normally executed, the execution of the position deviation correction process in low accuracy can be prevented.

Next, the CPU **74** calculates the elapsed time T**2** since the execution time N of the density correction process, and compares the elapsed time T**2** with the reference time G stored in the memory **72** (S**108**). When the elapsed time T**2** is shorter than the reference time G (S**108** is YES), after executing the position deviation correction process (S**110**), the CPU **74** resets the elapsed time T**1** and starts counting the elapsed time T**1** again (S**111**). For the position deviation correction process, the processes are same as the processes described in the first exemplary embodiment by using the same names, and repeated explanation is omitted.

Meanwhile, when the elapsed time T**2** is longer than the reference time G (S**108** is NO), the CPU **74** sets the position deviation correction requirement to OFF (S**114**), and terminates the position deviation correction process. Generally, it is well known that the shorter the elapsed time since the previously executed correction process, the more likely the next correction process will succeed. In the invention, because the position deviation correction is not executed when the elapsed time T**2** since the execution time N of the previously executed density correction process is longer than the reference time G, the execution of the position deviation correction process in low accuracy can be prevented.

The CPU **74** stores the result of the position deviation correction process, and when the previously executed position deviation correction process is normally executed (S**112** is YES), sets the density correction requirement U to OFF (S**114**). Meanwhile, when the previously executed position deviation correction process is not normally executed (S**112** is NO), the result is stored in the correction history R. For example, when the temperature Q detected in S**102** is within the reference range X2, as shown in FIG. 15B, the correction history R corresponding to the reference range X2 is changed to "X".

When the previously executed position deviation correction process is not normally executed (S112 is NO), the CPU 74 does not set the position deviation correction requirement to OFF. In the second exemplary embodiment, because in the above case the position deviation correction requirement D is not set to OFF, when the temperature Q detected in the next correction process changes to a temperature within the reference range X corresponding to the correction history R showing "O", the position deviation correction process is definitely executed.

The present invention is not limited to the exemplary embodiments described by the above description and the drawings. For example, the following embodiments may also fall in the scope of the invention.

For example, the image forming apparatus is not limited to a color printer. It can be a monochrome printer, or a so called multi-functional device that includes a copy function, and the like.

Further, in the second exemplary embodiment, whether to execute the correction process is determined based on the temperature inside the printer **110**, but whether to execute the correction process can also be determined based on the humidity inside the printer **110** and both the temperature and the humidity inside the printer **110**. Further, the correction process, which has been determined to be executed or not, is not limited to the position deviation correction process. In the second exemplary embodiment, for the color deviation correction process, whether the correction process is executed is judged based on the temperature (S**104**), which is also suitable for the density correction.

Each of the technical elements described in this specification or the drawings has technical utility as a sole or various combinations thereof, and are not limited to combinations defined in the claims at the time of the filing of the application. Further, the technology exemplarily described in this specification or the drawings can simultaneously achieve a plurality of objects, and technical utility can be obtained when one of the plurality of objects is achieved.

What is claimed is:

1. An image forming apparatus comprising:
a forming unit configured to form an image on a relatively moving object, the image including a mark;
a first detection unit configured to detect the mark formed by the forming unit so as to obtain a first detection result;
a correction unit configured to execute a correction process in which an image forming condition of the image forming unit is changed based on the first detection result;
a setting unit configured to set the correction process not to be executed when a value related to a correction accuracy of the correction unit is lower than a reference value; and
a control unit configured to control the correction process based on the setting by the setting unit,
wherein the setting unit is configured to set a reference frequency of a correction frequency of the correction unit to decrease as the reference value decreases.

2. The image forming apparatus according to claim **1**, further comprising a memory configured to store a plurality of combinations of the reference value and the reference frequency.

3. The image forming apparatus according to claim **1**,
wherein when the value related to the correction accuracy of the correction unit is lower than the reference value, the setting unit sets the correction unit to execute the correction process based on a manual instruction.

4. The image forming apparatus according to claim **1**, further comprising a second detection unit configured to detect a surface condition of the object so as to obtain a second detection result,
wherein when the second detection result shows that the surface condition of the object is more deteriorated than a reference condition, the setting unit evaluates that the value related to the correction accuracy of the correction unit is lower than the reference value.

5. The image forming apparatus according to claim **4**,
wherein a detection mechanism is configured to serve as both the first detection unit and the second detection unit.

6. The image forming apparatus according to claim **4**,
wherein a detection mechanism is configured to detect the mark formed on the object and the surface condition of the object in a single operation.

7. The image forming apparatus according to claim **4**, further comprising a storage unit configured to store the second detection result obtained by the second detection unit or a third detection result obtained by a third detection unit in correspondence with information related to the first detection result of the correction process executed when the second detection result or the third detection result is obtained,
wherein the setting unit evaluates whether the value related to the correction accuracy of the correction unit is lower than the reference value based on the information stored in the storage unit.

8. The image forming apparatus according to claim **1**, further comprising a third detection unit configured to detect at least one of temperature and humidity inside the image forming apparatus so as to obtain a third detection result,
wherein when the third detection result is outside a reference range, the setting unit evaluates that the value related to the correction accuracy of the correction unit is lower than the reference value.

9. The image forming apparatus according to claim **8**,
wherein when the third detection result changes from the outside of the reference range to an inside of the reference range, the setting unit sets the correction process to be executed.

10. The image forming apparatus according to claim **1**,
wherein the correction unit includes:
a first correction unit configured to execute a first correction process that corrects a first image forming condition of the forming unit; and
a second correction unit configured to execute a second correction process that corrects a second image forming condition of the forming unit, and
the setting unit includes:
a first setting unit configured to set the first correction process not to be executed by the first correction unit under a first condition; and
a second setting unit configured to set the second correction process not to be executed by the second correction unit under a second condition that is different from the first condition.

11. The image forming apparatus according to claim **10**,
wherein the correction unit is configured to execute the second correction process after the first correction process,
wherein the setting unit includes a timing unit configured to measure a time period from the execution of the first correction process to the execution of the second correction process, and

wherein, when the time period measured by the timing unit is longer than a reference time period, the second setting unit is configured to evaluate that a value related to a correction accuracy of the second correction unit is lower than the reference value.

12. The image forming apparatus according to claim **10**,

wherein the first correction unit is configured to execute a density correction process as the first correction process,

wherein the second correction unit is configured to execute a position deviation correction process as the second correction process,

wherein the correction unit is configured to execute the second correction process after the first correction process has been executed, and

wherein the second setting unit is configured to evaluate whether a value related to a correction accuracy of the second correction unit is lower than the reference value based on information related to a result of the first correction process.

13. A non-transitory computer readable storing medium storing a computer program for causing an image forming apparatus, which includes an image forming unit, to perform a method of:

forming an image on a relatively moving object, the image including a mark;

detecting the mark so as to obtain a first detection result;

executing a correction process in which an image forming condition of the image forming unit is changed based on the first detection result;

setting the correction process not to be executed when a value related to a correction accuracy of the correction process is lower than a reference value; and

controlling the correction process based on the setting,

wherein the setting comprises setting a reference frequency of a correction frequency of executing the correction process to decrease as the reference value decreases.

14. An image forming apparatus comprising:

a forming unit configured to form an image on a relatively moving object, the image including a mark;

a particular detection unit configured to detect the mark formed by the forming unit so as to obtain a particular detection result;

a correction unit configured to execute a correction process in which an image forming condition of the image forming unit is changed based on the particular detection result;

a setting unit configured to set the correction process not to be executed when a value related to a correction accuracy of the correction unit is lower than a reference value;

a control unit configured to control the correction process based on the setting by the setting unit; and

a further detection unit configured to detect at least one of temperature and humidity inside the image forming apparatus so as to obtain a further detection result,

wherein when the further detection result is outside a reference range, the setting unit evaluates that the value related to the correction accuracy of the correction unit is lower than the reference value.

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